Parametrical Optics – Background and Trends of Development

O.Vlokh

Institute of Physical Optics, 23 Dragomanov Str., 79005 L'viv, Ukraine

Received: 21.05.2004

The term ‘parametric optics’ (or ‘parametric crystal optics’) is a title for the branch of nonlinear optics, which has appeared after creating the sources of high-power coherent optical radiation – lasers. Nevertheless, many effects of magneto-, electro- and piezooptics, in particular the Faraday and Voight effects, as well as the Pockels and Kerr effects, have been known beginning from XIX century. Moreover, those effects have promoted shaping the present-day electromagnetic view at the light nature and the physical optics sphere. It is well known that the effects of parametric optics, together with those of the nonlinear optics, are described following from the same nonlinear constitutive equations. The only difference is that, in the first case, they correspond to the change of optical parameters of the matter under the effect of external fields or internal fields coupled, e.g., with the order parameters at the structural phase transitions in ferroelectrics, ferroelastics or ferromagnets, while, in the second case, the interaction of high-intensity optical waves in the matter lead to the self-influence of the light, the changes in the light wave frequencies, etc.

On the first blush, it seems that the studies of classical effects of the parametric optics are already settled down. However, the needs of control of laser radiation have stimulated a new turn in studying the parametric optical effects. On this basis, new branches have recently appeared in physical optics, among them the parametric crystal optics with accounting for the spatial dispersion (electrogyration, piezo- and magnetogyration), the gradient optics, photorefraction, etc. Besides, new tools for communications have been found within the applied optics, based on the optoelectronics, optical technologies and integrated optics. It is worthwhile in this respect to remember the prevision of the Committee of Optical Sciences of the USA (May 6, 1998): “…the using of the properties of the light will lead to the revolution in technology and will have the total influence on the life in the next century”. Perhaps, the parametric optics should occupy a highly important place in this prevision. At least, the search, studies and applications of new optical effects give rise to the relevant prospects. Already by this time, the parametric optics of spatially modulated quantum states is developed. The birth of parametric bio-optics is not excluded, of which development would find potentially useful applications in biology and medicine. Expansion of methods of the parametric optics towards the studies of cosmic processes will form novel views at the structure and development of the Universe, as well as the concepts of space and time.